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Description

Multi-Electrode Catheter

The present invention relates to a multi-electrode catheter and in particular to a multi-electrode measurement catheter for measuring esophageal or diaphragmal electromyographic (EMG) signals.

It is known from, for example, US 5,802,560 and US 6,259,938 to provide a multi-electrode EMG measurement catheter that comprises a flexible, longitudinally extending, body for insertion into the esophagus of a patient and a plurality of externally mounted electrodes. The electrodes are located at longitudinally spaced apart positions at a caudal section of the body in order to receive, in use, diaphragmal EMG signals. A corresponding plurality of electrical conductors in the form of insulated wires is provided and is located within a lumen of the body. Each wire of the plurality is connected to an associated different one of the plurality of external electrodes and runs within the same lumen from the associated electrode to a cephalad section of the body where an external connection to an EMG signal processing system may be established.

According to the present invention there is provided a multi-electrode catheter as described in and characterised by the present Claim 1. By forming at least one lumen with at least a portion of the internal wall section having a conductive section which extends from the region of the electrode to the cephalad section then improvements in one or both constructional ease and electrical properties for the catheter may be achieved.

A lumen, in which one or more insulated conductors of one or more of the plurality of electrode assemblies are located, may be formed with its entire internal wall having one or

other of a continuous or a reticulated conductive surface so as to provide screening of the so located conductors.

By providing a plurality of lumens, each with at least a section of an internal wall having a conductive surface in electrical connection to an associated one electrode of the plurality of electrode assemblies then an electrical connection between each electrode and the cephalad section of the catheter can be relatively easily established.

Exemplary embodiments of the multi-electrode catheter according to the present invention will now be described with reference to the drawings of the accompanying figures of which:

Fig. 1 shows a schematic representation of a first embodiment of a catheter according to the present invention;
Fig. 2 shows a schematic representation of a second embodiment of a catheter according to the present invention; and
Fig. 3 shows a schematic sectional view of the catheter of Fig. 2.

Considering now Fig. 1, a multi-electrode catheter 2 is illustrated not to scale since for a typical esophageal catheter for example, the length L will be in the region of 120cm-150cm and the width W will be in the region of 2mm-4mm. However, it is to be appreciated that these sizes are provided for illustration only.

The catheter 2 of the present example comprises a longitudinally extending body 4 having a caudal section 6 and a cephalad section 8. As with known catheter arrangements, this body 4 may be formed from, for example, polyurethane and is provided with one or more longitudinally extending lumens 10a-f. An electrically conducting surface 12 is provided that covers, in the present example, the entire inner wall 14 of

at least one 10a of the lumens 10a-f and that extends along the catheter 2 from the caudal section 6 to the cephalad section 8 so as to be substantially longitudinally co-extensive with the lumen 10a.

A plurality (three being illustrated) of electrode assemblies is also provided as part of the catheter 2. Each assembly comprises an electrode 16a-c (which may or may not all be of the same type), located on an external surface 18 of the caudal section 6 of the body 4, and an associated electrical conductor, here in the form of an insulated wire, 20a-c that extends longitudinally from its associated electrode 16a-c to the cephalad section 8 of the catheter 2. The electrodes 16a-c of the plurality of assemblies are arranged on the external surface 18 of the catheter body 4 spaced apart longitudinally from one another at locations that for the present embodiment are suitable for the measurement of diaphragmal EMG signals.

In the present embodiment, each wire 20a-c runs within the same lumen 10a that is formed with the electrically conductive surface 12 which acts to provide electrical shielding for the wires 20a-c. It will be appreciated that the conductive surface 12 need not cover the entire inner wall 14 in order to provide the necessary electrical shielding, a reticulated, mesh-like, structure may also be suitable under certain conditions.

Where more than one lumen 10a, 10d (in the present example) is provided with the covering conductive surface 12 then one or more of the insulated wires (here illustrated by the line 20c') may run in the other such lumens 10a, 10d. It will be appreciated that the external surface 18 may also be made electrically conducting to provide electrical shielding for the wires. The electrodes 16a-c will then be electrically isolated from the external surface 18.

Considering now Fig. 2 and Fig. 3, a catheter 22 comprises a longitudinally extending body 24 having a caudal section 26 and a cephalad section 28. As with known catheter arrangements and in common with that arrangement described in respect of Fig. 1, this body 24 is formed from, for example, polyurethane and is provided with a plurality of longitudinally extending lumens 30a-e. In the present embodiment only two of the lumens 30a,b are each provided with an electrically conducting surface 32a,b that, in the present example, covers entirely an inner wall 34a,b of the corresponding lumen 30a,b. Each conductive surface 32a,b extends from the caudal section 26 to the cephalad section 28 of the catheter 22 so as to be substantially longitudinally co-extensive with the associated lumen 30a,b.

A plurality of electrode assemblies, being no more in number than (here the same as) the number of lumens 30a,b having conducting surfaces 32a,b, is also provided as part of the catheter 2. Each assembly comprises an electrode 36 or 38 located on an external surface 40 of the caudal section 26 of the body 24, and an associated electrical contact 42a or b, that extends from the external surface 40 to a one of the conducting surfaces 32a or b of an associated lumen 30 a or b to provide an electrically conducive path between its associated electrode 36 or 38 and the conducting surface 32 a or b that now forms the electrical conductor of the assembly.

As can be seen from the sectional view of the catheter 22 through the electrode 36, that is shown in Fig. 3, the embodiment provides a first electrode assembly comprising a point electrode 36, being formed integral with an associated contact 42a which extends through the body 24 of the catheter 2 to contact its associated electrical conductor, the surface 32a, of the lumen 30a. An alternative point electrode arrangement is illustrated in the insert of Fig. 3 that depicts the lumen 30a. A hole 44, preferably with electrically conducting inner walls 46, connects the external

surface 40 with the conducting surface 32a, a portion 48 of which surface 32a also terminates the hole 44 to seal against ingress of fluid into the lumen 30a from external the catheter 22. In this manner the hole 44 and the terminating portion 48 of the conducting surface 32a effectively forms a point electrode.

There is also provided in the present embodiment a second electrode assembly comprising ring electrode 38 in electrical connection with its associated contact 42b which extends through the body 24 of the catheter 2 to contact its associated electrical conductor, the surface 32b, of the lumen 30b. The ring electrode 38, as well as the electrodes 16a-c of Fig. 1, may be formed in manners well known in the art, for example, by a physically separate metallic ring located about the outer surface 40 of the catheter 22, or by an integral conductive trace, formed, for example using sputtering or other deposition techniques.

It will be appreciated that the catheter according to the present invention may be provided with more electrode assemblies of similar construction and that some or all of the electrodes 36;38;44,48 of the plurality of assemblies may be identical.

Claims

1. A multi-electrode catheter (2;22) comprising a longitudinally extending body (4;24) having formed therein a number of longitudinally extending lumens (10a-f;30a-e); and a plurality of electrode assemblies, each one of which including an electrode (16a-c;36;38;44,48) located at an external surface (18;40) of a caudal section (6;26) of the body (4;24) and a connected electrical conductor (20a-c; 20c';32a-b) extending longitudinally within a lumen (10a;10d;30a;30b) of the number of lumens (10a-f;30a-e) to a cephalad section (8;28) of the body (4;24); characterised in that the lumen (10a;10d;30a;30b) within which the electrical conductor (20a-c;20c';32a-b) extends is formed with at least a portion of an internal wall (14;34a;34b) having an associated conductive surface (12;32a;32b) substantially longitudinally co-extensive with the lumen (10a;10d;30a;30b).

2. A multi-electrode catheter (2) as claimed in claim 1 characterised in that the electrical conductor of each assembly comprises a longitudinally extending electrically insulated conductor (20a-c;20c'); and in that the lumen (10a;10d) within which the insulated conductor(20a-c;20c') extends is formed with the associated conductive surface (14) covering the internal wall (12) to form an electrical shielding.

3. A multi-electrode catheter as claimed in claim 2 characterised in that all electrically insulated conductors (20a-c) of the plurality of electrode assemblies extend within a same lumen (10a).

4. A multi-electrode catheter 22 as claimed in claim 1 characterised in that the associated conductive surface (32a;32b) of each of the plurality of the longitudinally extending lumens (30a;30b), is provided in

electrical connection with a different one of the electrodes (36;38;44,48) of the plurality of electrode assemblies to form the electrical conductor.

Multi-Electrode Catheter

Abstract

A multi-electrode catheter (2) comprises a longitudinally extending body (4) of length L and width W formed with a number of longitudinally extending lumens (10a-f). A plurality of electrode assemblies is provided, each one having an electrode (16a-c) located at an external surface (18) of a caudal section (6) of the body (4) and a connected electrical conductor (20a-c, 20c') that extends longitudinally within a one (10a;10d) of the number of lumens (10a-f;30a-e) to a cephalad section (8;28) of the body (4;24). Each lumen (10a;10d) within which an electrical conductor (20a-c;20c') extends is formed with at least a portion of an internal wall (14) having an associated conductive surface (12) substantially longitudinally co-extensive with the lumen (10a;10d).

Fig. 1

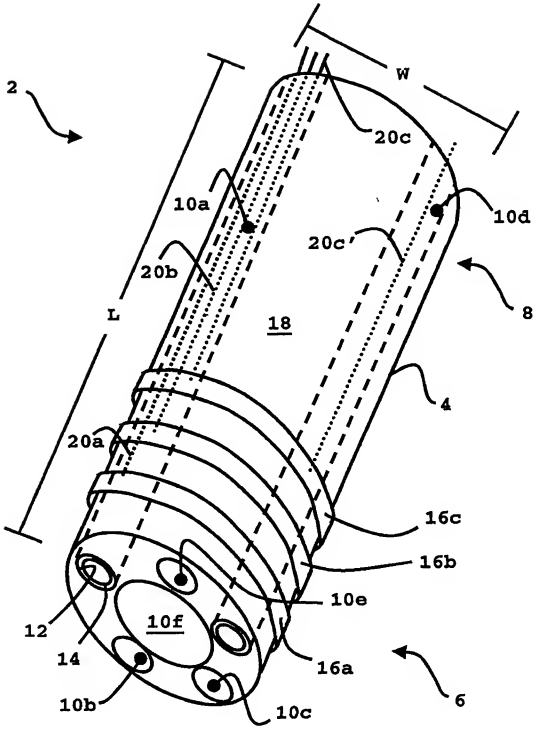

Fig. 1

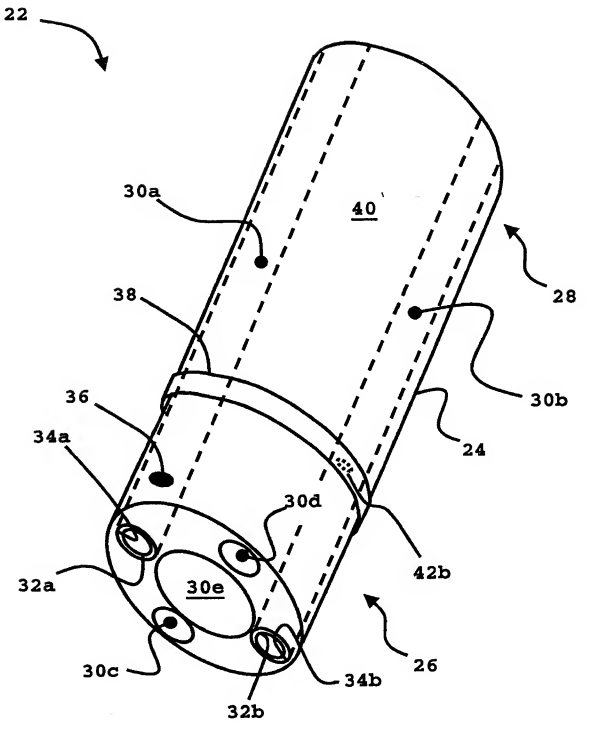

Fig. 2

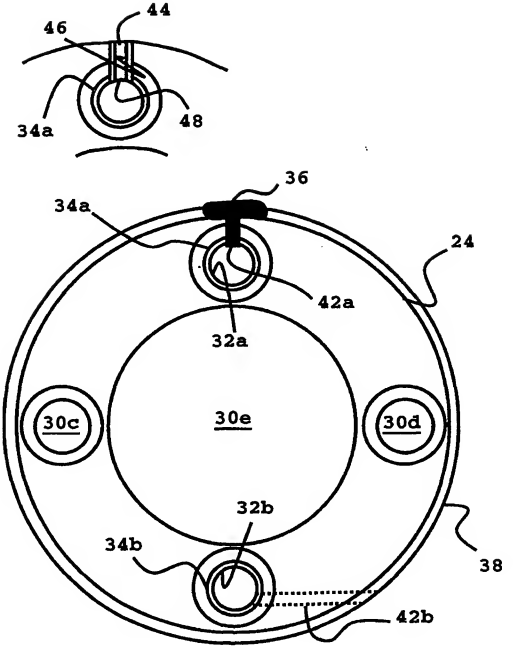

Fig. 3